US Environmental Protection Agency

Stopover Ecology of Neotropical Migratory Birds

What is Stopover Ecology?

Imagine you are a migrant bird looking for a stopover. Within a forest patch, you see variations in tree height, understory density, canopy closure, species diversity, and other factors important for finding the next juicy caterpillar. Now fly above the forest canopy, and the picture changes. You now see that the nearby collection of patches varies in size, shape, amount of forest, and degree of disturbance. You can tell that the patch 200 meters away is actually better habitat, because you understand the broad-scale connection between habitat and the number of caterpillars or predators awaiting you within. When night comes, you set your internal compass and set off toward your breeding home in the north. You fly a few hours, covering whatever distance your fuel load will allow, and arrive at a place you may never have been; but even in low light you can recognize overall habitat differences, and you pick one stopover from the collection of nearby stopovers. During spring migration, nocturnally migrating forest birds go through this scenario each night as they make their way north. Successful migration requires both suitable habitat at each stopover and a suitable distribution of stopovers along the migratory route. *Stopover Ecology* is the study of stopover habitats: their composition, distribution, and overall importance to the survival of migratory birds. Historically, studies of stopover ecology have concentrated on fine-scale composition of particular stopovers. There have been relatively few studies examining the broad-scale distribution of stopovers and how birds select one stopover from a collection of nearby stopovers.

Broad-scale Environmental Assessment

EPA's Regional Vulnerability Assessment (ReVA) is charged with quantifying existing environmental condition and assessing future risk to environmental resources. One way of doing this is to identify a species or group of species that respond to broad-scale landscape features. Migratory birds do this during their annual journey between continents. Migration in birds is controlled by hereditary instincts for habitat and flight direction. While habitat selection remains consistent through generations, flight direction is constantly modified by slight genetic differences in navigation. Consequently, each generation of birds produces individuals that fly slightly different flight paths, sampling many different routes. Survivors pass on a genetic disposition for intact routes. In this way an entire species evaluates habitat at a continental scale. The pattern of habitat use and disuse may highlight regional patterns of intact and disrupted pathways.

Migratory birds cover large distances, making them an excellent broad-scale environmental indicator

Which Broad-scale Factors Affect Migrants?

Migratory birds select stopovers in the early morning while flying. To capture this habitat selection, we identified a few environmental variables available in regional data sets that show an empirical connection to migrant abundance. We focused on factors that vary from one forest patch to another and can be assessed from the air in low light. Working with citizen scientists, we sampled 128 forest patches and correlated forest migrant abundance with these environmental factors. Forest migrants are more abundant in unfragmented, dense forest areas with relatively open understories and little coniferous canopy cover, and in intact riparian forest habitat. Migrants also show an aversion to human-altered habitats, particularly agricultural landcover and landscapes with high road density. These factors influence stopover selection, and regional maps combining these factors highlight intact migratory flyways.

Landscape Variables

- Forest Fragmentation
- Forest Area Density
- Forest Patch Shape
- Percent Forest
- Percent Coniferous Forest
- Riparian Forest
- Riparian Agriculture
- Percent Agriculture
- Road Density
- Percent Deciduous Forest
- Forest Patch Area

Site-specific Variables

- Percent low cover saplings
- Percent low cover shrubs
- Percent canopy cover coniferous
- Percent canopy cover
- Percent canopy cover deciduous
- Percent low cover
- Canopy height

Variables in blue are important predictors; others did not improve predictions significantly

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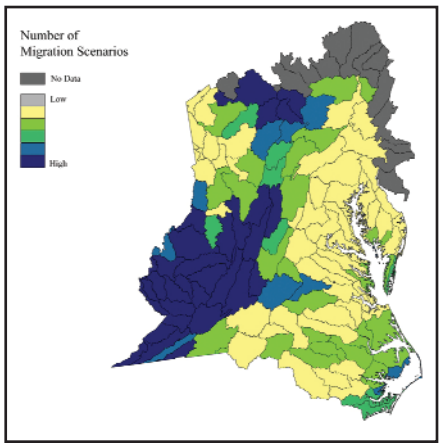
Assessing Migratory Pathways

As noted above, the distribution of intact stopovers may be as important as the condition of individual stopovers. We modeled migratory flights based on flight distance and direction to examine how nightly flights link stopovers into flyways. The resulting maps highlight portions of the landscape that are important for the continued success of migratory birds. Areas where many different migration scenarios overlap are particularly important, as these areas will support a diverse collection of migratory strategies and populations.

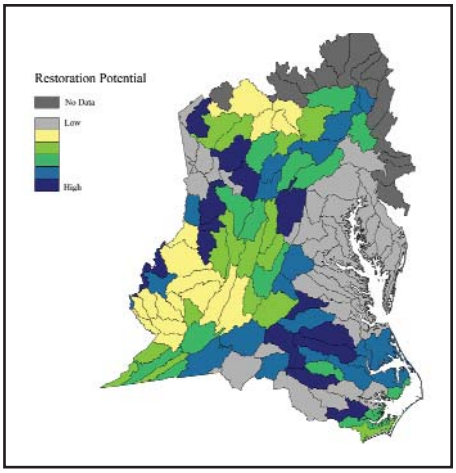
The Importance of Mid-Atlantic Region Watersheds

The Appalachian Mountains are a key feature for migration in the eastern United States, with most pathways using some portion of the Appalachians during migration. The Mid-Atlantic region is particularly important, encompassing the northern Appalachians and harboring a great number of migratory species both during migration and during the breeding season. This region also faces many environmental stressors which may degrade migratory habitats in the future. Using the models developed here, we can examine future scenarios of stressors such as urban development, climate change, and deforestation to determine how they may impact migratory birds.



Prioritizing Areas for Restoration

Using regional data sets we can identify locations where the restoration of forested habitats could have a positive effect on the migration of birds. Watersheds (or other mapping units) that have some prime habitat are good candidates for restoration, particularly if simple changes in forest extent or connectivity creates large stopovers. The map of restoration potential can then be combined with other



ReVA products to highlight watersheds where restoration could benefit many environmental services and wildlife species.

Additional Reading

Moore, F.R. and D.A. Aborn. 2000. Mechanisms of en route habitat selection: How do migrants make habitat decisions during stopover? Studies in Avian Biology 20: 34-42.

Tankersley, Jr., R. and K. Orvis. 2003. Modeling the geography of migratory pathways and stopover habitats for neotropical migratory birds. Conservation Ecology 7(1): 7. [online] URL: http://www.consecol.org/vol7/iss1/art7

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